Indicative simplified baseline and monitoring methodologies
for selected small-scale CDM project activity categories

TYPE I - RENEWABLE ENERGY PROJECTS

~~*Note: Categories I.A, I.B and I.C involve renewable energy technologies that supply electricity, mechanical and thermal energy, respectively, to the user directly. Renewable energy technologies that supply electricity to a grid fall into category I.D.*~~

Project participants shall take into account the general guidance to the methodologies, information on additionality, abbreviations and general guidance on leakage provided at http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html.

I.C. Thermal energy for the user with or without electricity

Technology/measure

1. This category comprises renewable energy technologies that supply individual households or users with thermal energy that displaces fossil fuels. Examples include solar thermal water heaters and dryers, solar cookers, energy derived from renewable biomass for water heating, space heating, or drying, and other technologies that provide thermal energy that displaces fossil fuel. Biomass-based co-generating systems that produce heat and electricity are included in this category.

2. Where thermal generation capacity is specified by the manufacturer, it shall be less than 45 MW.

3. For co-fired[1] systems the aggregate installed capacity (specified for fossil fuel use) of all systems affected by the project activity shall not exceed 45 MW_{th}. Cogeneration projects that displace/ avoid fossil fuel consumption in the production of thermal energy (e.g. steam or process heat) and/or electricity shall use this methodology. The capacity of the project in this case shall be the thermal energy production capacity i.e., 45 MW_{th}.

4. In the case of project activities that involve the addition of renewable energy units at an existing renewable energy facility, the total capacity of the units added by the project should be lower than 45 MW_{th} and should be physically distinct[2] from the existing units.

Boundary

5. The physical, geographical site of the renewable energy generation delineates the project boundary.

Baseline

6. For renewable energy technologies that displace technologies using fossil fuels, the simplified baseline is the fuel consumption of the technologies that would have been used in the

[1] Co-fired system uses both fossil and renewable fuels.

[2] Physically distinct units are those that are capable of producing thermal energy without the operation of existing units, and that do not directly affect the mechanical, thermal, or electrical characteristics of the existing facility. For example, the addition of a steam turbine to an existing combustion turbine to create a combined cycle unit would not be considered “physically distinct”.

absence of the project activity times an emission coefficient for the fossil fuel displaced. IPCC default values for emission coefficients may be used.

7. Cogeneration projects shall use one of the five following options for baseline emission calculations depending on the technology that would have been used to produce the thermal energy and electricity in the absence of the project activity:

(a) Electricity is imported ~~supplied~~ from the grid and steam/heat is produced using fossil fuel;

(b) Electricity is produced in an onsite captive power plant (with a possibility of export to the grid) and steam/heat is produced using fossil fuel;

(c) A combination of (a) and (b);

(d) Electricity and steam/heat are produced in a cogeneration unit, using fossil fuel.

(e) Electricity is imported from the grid and/or produced in an on-site captive power plant (with a possibility of export to the grid); steam/heat is produced from renewable biomass [3].

8. Baseline emissions for electricity produced in captive plants shall be calculated as the amount of electricity produced with the renewable energy technology (GWh) multiplied by the CO_2 emission factor per unit of energy of the fuel that would have been used in the baseline plant in (tCO2 / TJ) divided by the efficiency of the captive plant.

9. Baseline emissions for electricity imported ~~supplied~~ from the grid shall be calculated as the amount of electricity produced with the renewable energy technology (GWh) multiplied by the CO_2 emission factor of that grid. The emission factor for grid electricity shall be calculated as per the procedures detailed in AMS I.D.

10. For steam/heat produced using fossil fuels the baseline emissions are calculated as follows:

$$BE_y = HG_y * EF_{CO2} / \eta_{th} \qquad \textbf{(1)}$$

Where:

BE_y the baseline emissions from steam/heat displaced by the project activity during the year y in tCO_2e.

HG_y the net quantity of steam/heat supplied by the project activity during the year y in TJ.

EF_{CO2} the CO_2 emission factor per unit of energy of the fuel that would have been used in the baseline plant in (tCO_2 / TJ), obtained from reliable local or national data if available, otherwise, IPCC default emission factors are used.

[3] Baseline biomass consumption may include a small amount of complementary fossil fuel as under this scenario, no emission reduction can accrue on account of heat generation.

η_{th}	the efficiency of the plant using fossil fuel that would have been used in the absence of the project activity.

11. For cases ~~8~~ 7 (a), (b) and (c) baseline emissions must be calculated as the sum of emissions from the production of electricity and emissions from the production of steam/heat. For the case (c) the amount of electricity that would have been produced in the onsite power plant and the electricity that would have been exported or imported from the grid should be determined considering most recent historical records (average of the data from a minimum of three most recent years excluding abnormal years is required).

The emission factor for the displacement of electricity should reflect the emissions intensity of the captive power plant and the grid. If annual electricity produced in the project activity is less than or equal to the sum of captive generation and net grid import [4](average of most recent three years data), the emission factor shall be calculated as the weighted average of captive electricity generation and the net grid electricity import[5]. If annual electricity produced in the project activity is greater than the sum of captive generation and net grid import (average of most recent three years data), lower of the two i.e., emission factor of the grid or the emission factor of the captive plant shall be used for the incremental generation (i.e., the difference between the electricity generation in the project activity and the sum of captive generation and net grid import).

12. For electricity and steam produced in a cogeneration unit, using fossil fuel (case 7 (d)), the following formula shall be used:

$$BE_y = (HG_y + EG_y * 3.6) * EF_{CO2} / \eta_{cogen} \qquad \textbf{(2)}$$

Where:

BE_y	the baseline emissions from electricity and steam displaced by the project activity during the year y in tCO_2e.
EG_y	the amount of electricity supplied by the project activity during the year y in GWh
3.6	conversion factor, expressed as TJ/GWh.
HG_y	the net quantity of steam/heat supplied by the project activity during the year y in TJ.
EF_{CO2}	the CO_2 emission factor per unit of energy of the fuel that would have been used in the baseline cogeneration plant in (tCO_2 / TJ) obtained from reliable local or national data if available, otherwise IPCC default emission factors are used.
η_{cogen}	the total efficiency (thermal and electrical both included) of the cogeneration plant using fossil fuel that would have been used in the absence of the project activity. Efficiency should be calculated as total energy produced (electricity and steam/heat extracted) divided by thermal energy of the fuel used.

[4] Difference of total electricity imported from the grid and total electricity exported to the grid.

[5] For example in the baseline if 80% of annual electricity requirement was met by grid import and rest by captive generation, the weighted average emission factor (EF) would be $0.8\ EF_{grid} + 0.2\ EF_{captive}$.

13. Efficiency of the baseline units shall be determined by adopting one of the following criteria:

(a) Highest measured efficiency of a unit with similar specifications,

(b) Highest of the efficiency values provided by two or more manufacturers for units with similar specifications,

(c) Maximum efficiency of 100%.

14. For case 7 (e), baseline emissions from the production of electricity shall be calculated as per paragraph 11. Emission reductions from heat generation are not eligible.

15. In the case of project activities that involves the addition of renewable energy units at an existing renewable energy production facility, where the existing and new units share the use of common and limited renewable resources (e.g. biomass residues), the potential for the project activity to reduce the amount of renewable resource available to, and thus thermal energy production by, existing units must be considered in the determination of baseline emissions, project emissions, and/or leakage, as relevant.

For project activities that involve the addition of new energy production units (e.g., turbines) at an existing facility, the increase in energy production associated with the project (EG_y in MWh/ year) should be calculated as follows:

$$EG_y = TE_y - WTE_y \quad \textbf{(3)}$$

Where:

TE_y	the total thermal energy produced in year y by all units, existing and new project units
WTE_y	the estimated thermal energy that would have been produced by existing units (installed before the project activity) in year y in the absence of the project activity, where

$$WTE_y = MAX(WTE_{actual,y} , WTE_{estimated,y}) \quad \textbf{(4)}$$

Where:

$WTE_{actual,y}$	the actual, measured thermal energy production of the existing units in year y
$WTE_{estimated,y}$	the estimated thermal energy that would have been produced by the existing units under the observed availability of the renewable resource for year y;

If the existing units shut down, are derated, or otherwise become limited in production, the project activity should not get credit for generating thermal energy from the same renewable resources that would have otherwise been used by the existing units (or their replacements). Therefore, the equation for WTE still holds, and the value for $WTE_{estimated,y}$ should continue to be estimated assuming the capacity and operating parameters same as that at the time of the start of the project activity.

If the existing units are subject to modifications or retrofits that increase production, then WTEy can be estimated using the procedures described for EGbaseline below.

16. For project activities that seek to retrofit or modify an existing facility for renewable energy generation the baseline scenario is the following:

In the absence of the CDM project activity, the existing facility would continue to provide thermal energy ($EG_{baseline}$) at historical average levels ($EG_{historical}$), until the time at which the thermal energy facility would be likely to be replaced or retrofitted in the absence of the CDM project activity ($DATE_{BaselineRetrofit}$). From that point of time onwards, the baseline scenario is assumed to correspond to the project activity, and baseline thermal energy production ($EG_{baseline}$) is assumed to equal project thermal energy production (EG_y, in MWh/year), and no emission reductions are assumed to occur.

$$\mathbf{EG_{baseline} = MAX(EG_{historical}, EG_{estimated,y}) \text{ until } DATE_{BaselineRetrofit}}$$

$$\mathbf{EG_{baseline} = EG_y \text{ on/after } DATE_{BaselineRetrofit}}$$

Baseline emissions (BE_y in tCO_2 e) then correspond to the difference of the thermal energy supplied by the project activity minus the baseline thermal energy supplied in the case of modified or retrofit facilities ($EG_{baseline}$). EGhistorical is the average of historical thermal energy delivered by the existing facility, spanning all data from the most recent available year (or month, week or other time period) to the time at which the facility was constructed, retrofitted or modified in a manner that significantly affected output (i.e., by 5% or more). A minimum of 3 years (excluding abnormal years) of historical production data is required. In the case that 3 years of historical data are not available - e.g., due to recent retrofits or exceptional circumstances, a new methodology or methodology revision must be proposed. $EG_{estimated,y}$ is the estimated thermal energy that would have been produced by the existing units under the observed availability of renewable resource for year y.

In order to estimate the point in time when the existing equipment would need to be replaced in the absence of the project activity ($DATE_{BaselineRetrofit}$), project participants may take the following approaches into account:

(a) The typical average technical lifetime of the equipment type may be determined and documented, taking into account common practices in the sector and country, e.g. based on industry surveys, statistics, technical literature, etc.

(b) The common practices of the responsible company regarding replacement schedules may be evaluated and documented, e.g. based on historical replacement records for similar equipment.

(c) The point in time when the existing equipment would need to be replaced in the absence of the project activity should be chosen in a conservative manner, i.e., if a range is identified, the earliest date should be chosen.

Leakage

17. If the energy generating equipment is transferred from another activity or if the existing equipment is transferred to another activity, leakage is to be considered.

Monitoring

18. Monitoring shall consist of:

(a) Metering the energy produced by a sample of the systems where the simplified baseline is based on the energy produced multiplied by an emission coefficient.

OR

(b) Metering the thermal and electrical energy generated for co-generation projects.

OR

(c) If the emissions reduction per system is less than 5 tonnes of CO_2e a year:

(i) Recording annually the number of systems operating (evidence of continuing operation, such as on-going rental/lease payments could be a substitute); and

(ii) Estimating the annual hours of operation of an average system, if necessary using survey methods. Annual hours of operation can be estimated from total output (e.g. tonnes of grain dried) and output per hour if an accurate value of output per hour is available.

19. For projects where only biomass or biomass and fossil fuel are used the amount of biomass and fossil fuel input shall be monitored.

20. For projects consuming biomass a specific fuel consumption[6] of each type of fuel (biomass or fossil) to be used should be specified *ex ante*. The consumption of each type of fuel shall be monitored.

21. If fossil fuel is used, the thermal energy or the electricity generation metered should be adjusted to deduct thermal energy or electricity generation from fossil fuels using the specific fuel consumption and the quantity of fossil fuel consumed.

22. If more than one type of biomass fuel is consumed, each shall be monitored separately.

23. The amount of thermal energy or electricity generated using biomass fuels calculated as per paragraph 21 shall be compared with the amount of thermal energy or electricity generated calculated using specific fuel consumption and amount of each type of biomass fuel used. The lower of the two values should be used to calculate emission reductions.

[6] Specific fuel consumption is the fuel consumption per unit of thermal energy or electricity generated (e.g. tonnes of bagasse per MWh).

Project activity under a programme of activities

The following conditions apply for use of this methodology in a project activity under a programme of activities:

(a) In the specific case of biomass project activities the applicability of the methodology is limited to either project activities that use biomass residues only or biomass from dedicated plantations complying with the applicability conditions of AM0042 as in annex 1 of this document.

(b) In the specific case of biomass project activities the determination of leakage shall be done following the general guidance for leakage in small-scale biomass project activities (attachment C of appendix B) or following the prescriptions included in the leakage section of AM0042 as in annex 1 of this document.

(c) In case the project activity involves the replacement of equipment, and the leakage effect of the use of the replaced equipment in another activity is neglected, because the replaced equipment is scrapped, an independent monitoring of scrapping of replaced equipment needs to be implemented. The monitoring should include a check if the number of project activity equipment distributed by the project and the number of scrapped equipment correspond with each other. For this purpose scrapped equipment should be stored until such correspondence has been checked. The scrapping of replaced equipment should be documented and independently verified.

Annex 1

(APPLICABILITY CONDITIONS AND GUIDANCE ON LEAKAGE BELOW CONCERNS PROJECT ACTIVITY UNDER A PROGRAMME OF ACTIVITIES)

Applicability

1. The methodology is applicable under the following conditions:

- The project activity involves the installation of a new ~~grid-connected power~~ plant that is mainly fired with renewable biomass from a dedicated plantation (fossil fuels or other types of biomass may be co-fired);
- Prior to the implementation of the project activity, no ~~power~~ steam/heat was generated at the project site (i.e., the project plant does not substitute or amend any existing ~~power~~ generation at the project site);
- The geographic and system boundaries for the relevant electricity grid can be clearly identified and information on the characteristics of the grid is available;
- Biomass used by the project facility is not stored for more than one year;
- The dedicated plantation must be newly established as part of the project activity for the purpose of supplying biomass exclusively to the project.
- The biomass from the plantation is not chemically processed (e.g. esterification to produce biodiesel, production of alcohols from biomass, etc) prior to combustion in the project plant but it may be processed mechanically or be dried;
- The site preparation does not cause longer-term net emissions from soil carbon. Carbon stocks in soil organic matter, litter and deadwood can be expected to decrease more due to soil erosion and human intervention or increase less in the absence of the project activity;
- The land area of the dedicated plantation will be planted by direct planting and/or seeding;
- After harvest, regeneration will occur either by direct planting or natural sprouting;
- Grazing will not occur within the plantation;
- No irrigation is undertaken for the biomass plantations;
- The land area where the dedicated plantation will be established is, prior to project implementation, severely degraded and in absence of the project activity would have not been used for any other agricultural or forestry activity. The land degradation can be demonstrated using one or more of the following indicators:

  (a) Vegetation degradation, e.g.,

  - Crown cover of pre-existing trees has decreased in the recent past for reasons other than sustainable harvesting activities;

  (b) Soil degradation, e.g.,

- Soil erosion has increased in the recent past;
- Soil organic matter content has decreased in the recent past.

(c) Anthropogenic influences, e.g.,

- There is a recent history of loss of soil and vegetation due to anthropogenic actions; and
- Demonstration that there exist anthropogenic actions/activities that prevent possible occurrence of natural regeneration.

Furthermore, this methodology is only applicable if the most plausible baseline scenarios are:

- For power generation, electricity generated by the project would have been generated by existing and/or new power plants in the grid; and
- For the use of biomass residues, If biomass residues are co-fired in the project plant case B1, B2, B3, B4 and/or B5. If case B5 is the most plausible scenario, the methodology is only applicable if:

  (a) The plant where the biomass residues would be used as feedstock in the absence of the project activity can be clearly identified throughout the crediting periods; and

  (b) The fuels used as substitutes for the biomass residues at the plant, referred in (a) above, can be monitored by project participants.

Leakage

2. An important potential source of leakage for this project activity is an increase in emissions from fossil fuel combustion or other sources due to diversion of biomass ***residues*** from other uses to the project plant as a result of the project activity.

If biomass residues are co-fired in the project plant, project participants shall demonstrate that the use of the biomass residues does not result in increased use of fossil fuels or other GHG emissions elsewhere. For this purpose, project participants shall assess as part of the monitoring the supply situation for each type of biomass residue *k* used in the project plant. Table 6 below outlines the options that may be used to demonstrate that the biomass residues used in the plant did not increase fossil fuel consumption or other GHG emissions elsewhere.

Which approach should be used depends on the most plausible baseline scenario for the use of the biomass residues. Where scenarios B1, B2 or B3 apply, use approaches L_1, L_2 and/or L_3. Where scenario B4 applies, use approaches L_2 or L_3. Where scenario B5 applies, use approach L_4.

Table 6. Approaches to rule out leakage

L_1	Demonstrate that at the sites where the project activity is supplied from with biomass residues, the biomass residues have not been collected or utilized (e.g. as fuel, fertilizer or feedstock) but have been dumped and left to decay, land-filled or burnt without energy generation (e.g. field burning) prior to the implementation of the project activity. Demonstrate that this practice would continue in the absence of the CDM project activity, e.g. by showing that in the monitored period no market has emerged for the biomass residues considered or by showing that it would still not be feasible to utilize the biomass residues for any purposes (e.g. due to the remote location where the biomass residue is generated).
L_2	Demonstrate that there is an abundant surplus of the in the region of the project activity which is not utilized. For this purpose, demonstrate that the quantity of available biomass residues of type *k* in the region is at least 25% larger than the quantity of biomass residues of type *k* that are utilized (e.g. for energy generation or as feedstock), including the project plant.
L_3	Demonstrate that suppliers of the type of biomass residue in the region of the project activity are not able to sell all of their biomass residues. For this purpose, project participants shall demonstrate that the ultimate supplier of the biomass residue (who supplies the project) and a representative sample of suppliers of the same type of biomass residue in the region had a surplus of biomass residues (e.g. at the end of the period during which biomass residues are sold), which they could not sell and which are not utilized.
L_4	Identify the consumer that would use the biomass residue in the absence of the project activity (e.g. the former consumer). Demonstrate that this consumer has substituted the biomass residue diverted to the project with other types of biomass residues (and not with fossil fuels or other types of biomass than biomass residues[7]) by showing that the former user only fires biomass residues for which leakage can be ruled out using approaches L_2 or L_3. Provide credible evidence and document the types and amounts of biomass residues used by the former user as replacement for the biomass residue fired in the project activity and apply approaches L_2 or L_3 to these types of biomass residues. Demonstrate that the substitution of the biomass residues used in the project activity with other types of biomass residues does not require a significant additional energy input except for the transportation of the biomass residues.

Where project participants wish to use approaches L_2, L_3 or L_4 to assess leakage effects, they shall clearly define the geographical boundary of the region and document it in the draft CDM-PDD. In defining the geographical boundary of the region, project participants should take the usual distances for biomass transports into account, i.e., if biomass residues are transported up to 50 km, the region may cover a radius of 50 km around the project activity. In any case, the region should cover a radius around the project activity of at least 20 km but not more than 200 km. Once defined, the region should not be changed during the crediting period(s).

[7] The generation of other types of biomass than biomass residues may be involved with significant GHG emissions, for example, from cultivation or harvesting.

Project participants shall apply a leakage penalty to the quantity of biomass residues, for which project participants cannot demonstrate with one of the approaches above that the use of the biomass residue does not result in leakage. The leakage penalty aims at adjusting emission reductions for leakage effects in a conservative manner, assuming that this quantity of biomass residues is substituted by the most carbon intensive fuel in the country.

If for a certain biomass residue type *k* used in the project leakage effects cannot be ruled out with one of the approaches above, leakage effects for the year *y* shall be calculated as follows:

$$LE_y = EF_{CO2,LE} \cdot \sum_n BF_{LE,n,y} \cdot NCV_n \quad \textbf{(1)}$$

Where:

LE_y = Leakage emissions during the year *y* (tCO_2/yr)

$EF_{CO2,LE}$ = CO_2 emission factor of the most carbon intensive fuel used in the country (tCO_2/GJ)

$BF_{LE,n,y}$ = Quantity of biomass residue type *n* used for heat generation as a result of the project activity during the year *y* and for which leakage can not be ruled out using one of the approaches L_1, L_2, L_3 or L_4 (tons of dry matter or liter)

NCV_n = Net calorific value of the biomass residue type *n* (GJ/ton of dry matter or GJ/liter)

n = Biomass residue type *n* for which leakage can not be ruled out using one of the approaches L_1, L_2, L_3 or L_4

In case of approaches L_1, $BF_{LE,n,y}$ corresponds to the quantity of biomass residue type *n* that is obtained from the relevant source or sources.

In case of approaches L_2 or L_3, $BF_{LE,n,y}$ corresponds to the quantity of biomass residue type *k* used in the project plant as a result of the project activity during the year *y* ($BF_{LE,n,y} = BF_{PJ,k,y}$, where *n*=*k*).

In case of approach L_4, $\left(BF_{LE,n,y} \cdot NCV_n\right)$ corresponds to the lower value of

(a) The quantity of fuel types *m*, expressed in energy quantities, that are used by the former user of the biomass residue type *k* and for which leakage can not be ruled out because the fuels used are either (i) fuels types other than biomass residues (e.g. fossil fuels or biomass types other than biomass residues) or (ii) are biomass residues but leakage can not be ruled out for those types of biomass residues with approaches L_2 or L_3; as follows:

$$BF_{LE,n,y} \cdot NCV_n = \sum_m FC_{former\ user,m,y} \cdot NCV_m \quad \textbf{(2)}$$

Where:

$BF_{LE,n,y}$	=	Quantity of biomass residue type *n* used for heat generation as a result of the project activity during the year *y* and for which leakage can not be ruled out using approach L_4 (tons of dry matter or liter)
NCV_n	=	Net calorific value of the biomass residue type *n* (GJ/ton of dry matter or GJ/liter)
n	=	Biomass residue type *n* for which leakage can not be ruled out using approach L_4
$FC_{former\ user,m,y}$	=	Quantity of fuel type *m* used by the former user of the biomass residue type *n* during the year *y* (mass or volume unit)
NVC_m	=	Net calorific value of fuel type *m* (GJ/ton of dry matter or GJ/liter)
m	=	Fuel type *m*, being either (i) a fuel type other than a biomass residue (e.g. fossil fuel or biomass other than biomass residues) or (ii) a biomass residues for which leakage can not be ruled out with approaches L_2 or L_3

(b) The quantity of biomass residue type *k*, expressed in energy quantities, used in the project plant during the year *y* ($BF_{LE,n,y} = BF_{PJ,k,y}$, where $n=k$).